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DEA AS A TOOL TO MEASURE BANK EFFICIENCY: A STUDY OF PUBLIC SECTOR BANKS IN INDIA

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ABSTRACT

Data Envelopment Analysis (originated in 1957) uses a linear-programming method to identify the efficient DMUs. DEA is a powerful managerial tool for performance measurement and it has been widely used for assessing the efficiency of the public and private sectors. Literature suggests that DEA is a highly objective benchmarking technique particularly well suited to such multi-office organizations as bank branches. Considering the advantage of Data Envelopment Analysis (DEA) over other techniques of measuring efficiency, the present study endeavours to measure efficiency of Indian Public Sector Banks using DEA. A database for public sector banks operating in India was collected from the Reserve Bank of India for the year 2013. The CCR model of DEA was used taking four inputs as owned funds, deposits, borrowings and wage bills whereas Spread and other income have been taken as outputs. It was found that majority of the public sector banks are inefficient. Majority of State Bank group banks are efficient and majority of nationalised banks are inefficient. Further, the excessive borrowings are the major source of inefficiency followed by unutilised deposits, owned funds and wages. It was concluded that in order to improve efficiency, public sector banks should improve their credit-deposit ratio and should reduce the level of borrowings.

KEYWORDS: Data Envelopment Analysis, Public Sector Banks, CCR Model, Benchmarking, Efficiency Analysis

INTRODUCTION

'Sustainability' is a buzzword in today's business scenario. Sustainability can be achieved by efficient use of input resources and by bringing effectiveness in outputs. It means 'efficiency' is the key to sustainability. Efficiency is easy to measure in manufacturing sector where the inputs and outputs relationship can be established by using data. But the same becomes altogether difficult in service sector as services are tough to quantify. Efficiency is calculated as the ratio of output to input variable. The existing literature on measurement of efficiency in the service sector suggests that there are tools to measure efficiency namely,ratio analysis, regression analysis, growth accounting, parametric methods like Stochastic Frontier analysis(SFA), Thick Frontier analysis (TFA) and Distribution free-approach (DFA) or non- parametric efficient frontier techniques i.e. Data envelopment analysis (DEA) (Pariouras, 2008). Out of all these tools, DEA is a 'mathematical programming model' applied to observational data that provides a new way of obtaining empirical estimates of relations (Charnes, Cooper and Rhodes, 1978). The present study focuses on application of DEA to measure the efficiency.

DATA ENVELOPMENT ANALYSIS

Existing Literature considers the inception of DEA in 1957, when Farrel proposed an activity analysis approach that could be applied to any productive organisation, for evaluating productivity. Farrel (1957) suggested the construction of the frontier as a piece-wise linear combination of most efficient units. Thereafter, Charnes (1978) used a linear-programming method to identify the efficient DMUs and coined the method DEA. Charnes et al., designed DEA for public sector programs in which the managers of various DMU's were not free to divert resources to other programs for more profit. They had an intention to evaluate the accomplishments or resource conservation possibilities, for every DMU with the resources assigned to it. The original CCR model, first proposed by Charnes, Cooper and Rhodes, was applicable only to technologies characterized by constant returns to scale globally. Further, Banker, Charnes and Cooper (BCC), (1984), extended the CCR model to accommodate technologies that exhibit variable returns to scale.

The major advantage of DEA as coined by Emrouznejad and Cabanda is that it does not require specification of functional forms for the frontier of performance possibilities compared to traditional statistical regression techniques. Similarly, Sekhri (2011) points out that DEA has several advantages over the Regression analysis and the ratio analysis. Regression analysis considers the average behaviour of all units whereas DEA focuses on the outliers within the data set, identifying the units which achieve the best result. Also, unlike Ratio analysis, DEA can simultaneously consider multiple inputs and outputs. It can also consider categorical, exogeneous or qualitative data. Yang (2011), stated that compared to other approaches, DEA is a better way to organize and analyse data since it allows efficiency to change over time and requires no prior assumption on the specification of the best practice frontier. Also, it permits the inclusion of random errors if necessary. Also Leibenstein and Maital (1992), argue that DEA is a superior method for measuring overall technical inefficiency. DEA supplies new insights into activities that have previously been evaluated by other methods (Cooper, Seiford and Tone, 2000). According to Cooper, Seiford and Zhu(2004),"DEA is a relatively new 'Data oriented' approach for evaluating the performance of a set of peer entities, called Decision Making Units(DMUs) which convert multiple inputs into multiple outputs."

DEA is most widely used technique adopted to measure a firm's performance (Emrouznejad et al.,2008). Sherman and Ladino (1995) opined that in addition to banking, DEA has provided insights into ways to improve productivity in government services (Sherman,1989), health maintenance organization services(Chilingerian and Sherman 1994) and security brokerage services(Bank technology report, 1992). Emorouznejad and Anouze (2010) state that DEA is a powerful managerial tool for performance measurement and it has been widely used for assessing the efficiency of the public and private sectors. Further supporting DEA, According to Sherman and Gold (1985), DEA is a highly objective benchmarking technique particularly well suited to such multi-office organizations as bank branches. Considering the advantage of Data Envelopment Analysis (DEA) over other techniques of measuring efficiency, the present study endeavours to measure efficiency of Indian Public Sector Banks using DEA.

REVIEW OF LITERATURE

This section reviews the studies conducted in India and abroad.

Srivastava, Aman and Gupta (2009) examined 54 commercial banks of India, during 2004-2008, using non-parametric technique DEA, separately for each year. The average efficiency was found to be 90 percent using operations approach whereas using intermediation approach efficiency declined to 70 percent. Pal and Bishnoi (2009) used Malmquist

Index to explain the productivity growth of Indian banking sector. The authors examined panel data of 63 commercial banks from 1996-2005. They found that the sampled banks experienced highest growth on basis of value addition of 5.7% followed by asset approach with 2.5% whereas income approach based productivity has gained 0.6% growth rate. Subramanyam, Venkateswarlu and Reddy (2010) calculated the efficiency of 22 Indian commercial banks and only 59% banks were efficient. Sekhri (2011) compared 62 Indian public sector banks, private sector banks and foreign banks for the period 2004-09, using Malmquist TFP growth measure. It was found that the foreign sector banks scored a high TFP mainly because of their high technical efficiency change and the public sector banks performed better than foreign & private banks in pure efficiency change index. Ganesan (2009) examined the technical efficiency of 30 State Cooperative Banks (SCBs) and 20 District Central Cooperative Banks (DCCBs) in India, using data envelopment analysis, during the period 2002-06. They found that the mean efficiency (in percentage) of SCBs during 2002-2006 was 74.5 while that of DCCBs was 72.51.

Similarly studies have been done outside India. Alkhathlan and Malik (2010) evaluated the relative efficiency of Saudi Banks from 2003 through 2008 using CCR and BCR models of Data envelopment analysis(DEA). Yang (2009) evaluated 240 branches of Canadian Bank in Greater Toronto area using BCC model of data envelopment analysis (DEA). Jemric, Igor and Boris (2002) analysed the bank efficiency in Croatia during 1995-2000 using CCR and BCC models of Data Envelopment Analysis (DEA). Sultan, Bilal and Abbas (2011) used a Two-stage DEA model to evaluate the performance of ten banks listed in Karachi stock exchange, Pakistan for the period 2005-2009. Arslan and Ergec (2010) analysed the efficiencies of 26 private conventional banks and 4 participation banks in Turkey, during 2006-2009 through the data envelopment analysis(DEA). Lin, Hsu and Hsiao (2007) investigated the relative efficiency of management and variation of managerial efficiency among 37 domestic banks in Taiwan, using data envelopment analysis(DEA)and Malmquist Index. Gitau and Gor (2011) used DEA method to measure Malmquist index of total factor productivity for a sample of 34 commercial banks in Kenya for the period 1999-2008. Pasiouras (2008) analysed a sample of 715 publicly quoted commercial banks operating in 95 countries during 2003, using two–stage DEA. Qureshi and Shaigh (2012) analysed the comparative efficiency of banking system in Pakistan, comprising of Islamic banks, conventional banks with Islamic banking division and conventional banks by using ratio analysis and data envelopment analysis(DEA). Akbari, Dahmardeh and Saravani (2012) carried out efficiency analysis of Bank RefahKargaran Branches in Sistan and Baluchistan(S&B) in the financial year 2009-10 using CCR and BCC models of Data Envelopment Analysis(DEA).

GAP ANALYSIS

From the existing review of literature, it was found that most of the studies conducted abroad used CCR model of DEA to measure bank efficiency. In India, attempts have been made to study efficiency of either commercial banks or co-operative banks, using DEA, till 2009. Either these studies had considered all commercial banks or selected commercial banks including Public sector banks, Private sector banks and Foreign banks. But there is a huge gap in operation, climate and work culture amongst commercial banks on the basis of their ownership structure. The working culture of public sector banks is different from new generation private sector banks and ultra-modern high technology based foreign banks. Secondly, these studies have been conducted only upto the year 2009. So, thepresent study has been undertaken to fill in the gap by measuring sector specific efficiency of Indian Public Sector banks for the year2013.

OBJECTIVES

Although, the main objective of the present study is to measure efficiency of Indian Public Sector banks using non-parametric technique of measuring efficiency i.e. Data Envelopment Analysis (DEA). However, the specific objectives are as follows:

- To analyse the efficiency of Public Sector Banks operating in India.
- To examine the sources of inefficiency amongst Public Sector Banks of India.
- To ascertain the benchmarks for the less efficient banks

HYPOTHESIS

On the basis of above stated objectives, following hypotheses have been created

$H_{1,0}$: Majority of the Public Sector Banks are inefficient.

$H_{1,1}$: Majority of the Public Sector Banks are efficient.

$H_{2,0}$: Majority of the banks in the State Bank Group are inefficient.

$H_{2,1}$: Majority of the banks in the State Bank Group are efficient.

$H_{3,0}$: Majority of the banks in the Nationalized Bank Group are inefficient.

$H_{3,1}$: Majority of the banks in the Nationalized Bank Group are efficient.

$H_{4,0}$: Lack of other income is the main source of inefficiency in Public Sector banks.

$H_{4,1}$: Lack of other income is not the main source of inefficiency in Public Sector banks.

$H_{5,0}$: Utilization of input variables i.e. Capital, Business and Wage Bills is the main source of inefficiency.

$H_{5,1}$: Utilization of input variables i.e. Capital, Business and Wage Bills is not the main source of inefficiency.

DATA BASE AND RESEARCH METHODOLOGY

The present study is based on efficiency evaluation of 26 public sector banks operating in India, for the year 2013, as per the list given in table 1. The source of data used in present study is secondary data collected from the Statistical Tables Related to Banks in India published by the Reserve Bank of India. The CCR model of DEA uses an input oriented approach, assuming a constant returns to scale, thus it is a natural choice to assess the bank performance (Yang, 2009). In CCR DEA framework, we have taken four inputs as owned funds, deposits, borrowings and wage bills whereas Spread and other income have been taken as outputs.

Table 1: List of Banks under Study

SBI & Associates	Other Nationalized Banks	Other Public Sector Bank
1. State Bank of India 2. State Bank of Bikaner and Jaipur 3. State Bank of Hyderabad 4. State Bank of Mysore 5. State Bank of Patiala 6. State Bank of Travancore	1. Allahabad Bank 2. Andhra Bank 3 . Bank of Baroda 4. Bank of India 5. Bank of Maharashtra 6. Canara Bank 7. Central Bank of India 8 . Corporation Bank	1. IDBI Bank

	9 . Dena Bank 10. Indian Bank 11. Indian Overseas Bank 12. Oriental Bank of Commerce 13. Punjab National Bank 14. Punjab and Sind Bank 15. Syndicate Bank 16. UCO Bank 17. Union Bank of India 18. United Bank of India 19. Vijaya Bank	

BASIC MATHEMATICAL FORMULATION OF DEA

Charnes, Cooper and Rhodes (1978) introduced a linear programming technique to measure the efficiency of Decision Making Units (DMUs) in a competitive environment where similar inputs are employed to produce similar outputs.

Suppose, we have 'n' decision making units (DMUs) with 'm' inputs and 's' outputs and the $DMU_j, j = 1,2,....,n$ is to be evaluated under investigation with input and output vectors $X_j = (x_{1j}, x_{2j}, ...x_{mj})$ and $Y_j = (y_{1j}, y_{2j}, ...y_{sj})$ where $X_j \geq 0,\ Y_j \geq 0, X_j \neq 0$ and $Y_j \neq 0$.

The basic CCR model to evaluate the input technical efficiency of DMU_k is

$$\theta = Max \sum_{r=1}^{s} u_r y_{rk}$$

subject to

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0, \quad j = 1,2,...n \qquad \text{---------- (1)}$$

$$\sum_{i=1}^{m} v_i x_{ik} = 1$$

$$u_i, v_j \geq \varepsilon \quad , \ i = 1,2,...,m; \ j = 1,2,....,n$$

u_i and v_j are the output and input weights, which are computed by solving the above equation (1). The DMU_k is said to be an efficient with the optimum weights (u^*, v^*) if and only if $\theta^* = 1$, otherwise DMU_k is said to be an inefficient.

ANALYSIS

Table 2 presents the relative efficiency scores of banks. Efficiency scores indicate that 12 out of 26 banks under study are fully efficient banks with 100% efficiency score. They are the State Bank of India, the State Bank of Bikaner and Jaipur, the State bank of Hyderabad and the State bank of Mysore, the Bank of Baroda, the Corporation Bank, the IDBI Bank, the Indian Bank, theOriental Bank of Commerce, the Punjab National Bank, the UCO Bank and the United Bank of India.

Table 2: Relative Efficiency Score of Banks under Study

Name of the Bank	Efficiency Score
State Bank of India	100%
State Bank of Bikaner and Jaipur	100%
State Bank of Hyderabad	100%
State Bank of Mysore	100%

Table 2: Contd.,	
State Bank of Patiala	93%
State Bank of Travancore	94.6%
Allahabad Bank	88.7%
Andhra Bank	98.7%
Bank of Baroda	100%
Bank of India	95.6%
Bank of Maharashtra	95.2%
Canara Bank	85.7%
Central Bank of India	74.1%
Corporation Bank	100%
Dena Bank	93.7%
IDBI Bank	100%
Indian Bank	100%
Indian Overseas Bank	88.2%
Oriental Bank of Commerce	100%
Punjab National Bank	100%
Punjab and Sind Bank	79.8%
Syndicate Bank	96.2%
UCO Bank	100%
Union Bank of India	96.4%
United Bank of India	100%
Vijaya Bank	74.7%

Rest of the banks are relatively inefficient with efficiency scores less than 100%. Table 2 points out the inefficient banks as the State Bank of Patiala (93%), the State Bank of Travancore (94.6%), the Allahabad Bank (88.7%), the Andhra Bank (98.7%), the Bank of India (95.6%), the Bank of Maharashtra (95.2%), Canara Bank (85.7%), the Central Bank of India (74.1%), the Dena Bank (93.7%), the Indian Overseas Bank (88.2%), the Punjab and Sind Bank (79.8%), the Syndicate Bank (96.2%), the Union Bank of India (96.4%) and the Vijaya Bank (74.7%).

Table 3 gives the list of inefficient banks and for each relatively inefficient bank, there are benchmarks. These benchmarks for an inefficient unit is a group of efficient units, with same optimum weights as the inefficient unit.

As per Table 3, the State Bank of Patiala has the State Bank of Bikaner and Jaipur(0.74), the Corporation Bank(0.119) and the UCO Bank(0.032) as its benchmarks. Out of these, the State Bank of Bikaner and Jaipur is the nearest benchmark for it. Similarly, The State Bank of Travancore has the State Bank of Bikaner and Jaipur(0.694) and the United Bank of India(0.139) as its benchmark whereas the State Bank of Bikaner and Jaipur is its nearest benchmark.

Table 3: Inefficient Banks and their Benchmarks

Name of Bank	Benchmarks
State Bank of Patiala	State Bank of Bikaner and Jaipur(0.74), Corporation Bank(0.119), UCO Bank(0.032)
State Bank of Travancore	State Bank of Bikaner and Jaipur (0.694), United Bank of India (0.139).
Allahabad Bank	State Bank of Bikaner and Jaipur (0.342), State bank of Hyderabad(0.707), Corporation Bank(0.113), United Bank of India(0.335).
Andhra Bank	State bank of Hyderabad (0.166), State bank of Mysore(1.122), Corporation Bank(0.001), UCO Bank(0.227).
Bank of India	State Bank of India(0.043), State Bank of Bikaner and Jaipur(0.586), Corporation Bank(1.598), IDBI Bank(0.024).
Bank of Maharashtra	State Bank of Bikaner and Jaipur(0.884), State bank of Mysore(0.339),Corporation Bank(0.037), IDBI Bank(0.003).

Table 3: Contd.,	
Canara Bank	State bank of Mysore(1.121), Corporation Bank(0.285),Oriental Bank of Commerce(0.134), United Bank of India(1.694).
Central Bank of India	State Bank of Bikaner and Jaipur(1.527), State bank of Hyderabad(0.172), State bank of Mysore(0.548, Corporation Bank(0.039).
Dena Bank	State bank of Hyderabad(0.028), State bank of Mysore(0.21), Corporation Bank(0.124), UCO Bank(0.319).
Indian Overseas Bank	State Bank of India(0.042), State Bank of Bikaner and Jaipur(0.502), Corporation Bank(0.246), United Bank of India(0.503).
Punjab and Sind Bank	State bank of Hyderabad(0.25), Indian Bank(0.092), Oriental Bank of Commerce(0.052).
Syndicate Bank	State Bank of Bikaner and Jaipur(2.082), State bank of Hyderabad(0.027), UCO Bank(0.002).
Union Bank of India	State Bank of Bikaner and Jaipur(1.466), State bank of Mysore(1.074), Corporation Bank(0.526).
Vijaya Bank	State Bank of Bikaner and Jaipur(0.243), State bank of Hyderabad(0.093), Corporation Bank(0.173), UCO Bank(0.065).

The Allahabad Bank has four benchmarks namely the State Bank of Bikaner and Jaipur(0.342), the State bank of Hyderabad(0.707), the Corporation Bank(0.113), the United Bank of India(0.335) and the nearest benchmark is the State bank of Hyderabad. The Andhra Bank has the State bank of Hyderabad(0.166),the State bank of Mysore(1.122), the Corporation Bank(0.001) and the UCO Bank(0.227) as its benchmarks, the State Bank of Mysore being the nearest benchmark. Bank of India has four benchmarks, namely the State Bank of India(0.043), the State Bank of Bikaner and Jaipur(0.586), the Corporation Bank(1.598) andthe IDBI Bank (0.024), but the Corporation Bank is the nearest benchmark. Bank of Maharashtra has its benchmarks as the State Bank of Bikaner and Jaipur(0.884),the State bank of Mysore(0.339),the Corporation Bank(0.037) and the IDBI Bank (0.003), the State Bank of Bikaner and Jaipur is its nearest benchmark. Also, Canara Bank has four benchmarks. They are the State bank of Mysore(1.121), the Corporation Bank(0.285),the Oriental Bank of Commerce(0.134) and the United Bank of India(1.694), out of these, the United Bank of India is its nearest benchmark. Central Bank of India has the State Bank of Bikaner and Jaipur(1.527), the State bank of Hyderabad(0.172),the State bank of Mysore(0.548) and the Corporation Bank (0.039) as its benchmark, the State Bank of Bikaner and Jaipur is the nearest benchmark.

Dena Bank has its benchmarks namely the State bank of Hyderabad(0.028), the State bank of Mysore(0.21), the Corporation Bank (0.124) and the UCO Bank (0.319), the nearest benchmark is the UCO Bank. Indian Overseas Bank has State Bank of India(0.042), State Bank of Bikaner and Jaipur(0.502), Corporation Bank(0.246), United Bank of India(0.503). Benchmarks of the Punjab and Sind Bank are the State bank of Hyderabad(0.25), the Indian Bank (0.092) and the Oriental Bank of Commerce (0.052), the State Bank of Hyderabad is its nearest benchmark. The Syndicate Bank has three benchmarks, they are the State Bank of Bikaner and Jaipur(2.082), the State bank of Hyderabad (0.027) and the UCO Bank (0.002), the nearest benchmark is the State Bank of Bikaner and Jaipur. The Union Bank of India has the State Bank of Bikaner and Jaipur(1.466), the State bank of Mysore(1.074) and the Corporation Bank (0.526) as its benchmarks, nearest benchmark is the State Bank of Bikaner and Jaipur. Vijaya Bank has four benchmarks, they are the State Bank of Bikaner and Jaipur(0.243), the State bank of Hyderabad(0.093), the Corporation Bank(0.173) and the UCO Bank (0.065), nearest benchmark is the State Bank of Bikaner and Jaipur.

Further, Table 4 indicates the sources of inefficiencies for inefficient units. As per this table, the State Bank of Patiala, in order to enhance its efficiency, should decrease its deposits by Rs. 38910.79 Million and borrowings by Rs 20663.2 Million to achieve the same level of outputs. The State Bank of Travancore should decrease its deposits, borrowings and wage bills by Rs. 159256.881 Million, Rs. 35273.307Million and Rs. 211.553 Million respectively to produce same level of outputs, in order to become an efficient bank. The Allahabad Bank should decrease its deposits by Rs. 13911.857 Million to produce same outputs for improving its efficiency. The Andhra bank, Bank of India, Bank of Maharashtra, Central Bank of India, Dena Bank and Indian Overseas Bank should decrease their borrowings by Rs. 35841.377 Million, Rs. 8743.97 Million, Rs. 51384.912 Million, Rs. 10784.56 Million, Rs. 22922.484 Million and Rs. 48488.611 Million respectively to produce same level of outputs to become efficient.

Table 4: Sources of Inefficiency (Figures in Rs. Million)

Name of the Bank	Owned Funds	Deposits	Borrowings	Wage Bills	Spread	Other Income
State Bank of Patiala	0	38910.79	20663.2	0	0	0
State Bank of Travancore	0	159256.881	35273.307	211.553	0	0
Allahabad Bank	0	13911.857	0	0	0	0
Andhra Bank	0	0	35841.377	0	0	0
Bank of India	0	0	8743.97	0	0	0
Bank of Maharashtra	0	0	51384.912	0	0	0
Canara Bank	20771.689	0	0	0	0	0
Central Bank of India	0	0	10784.56	0	0	0
Dena Bank	0	0	22922.484	0	0	0
Indian Overseas Bank	0	0	48488.611	0	0	0
Punjab and Sind Bank	0	58192.152	0	0	0	316.004
Syndicate Bank	0	248081.284	0	0	0	3652.872
Union Bank of India	0	0	34306.102	0	0	0
Vijaya Bank	0	44135.743	0	0	0	0

The Punjab and Sind Bank should decrease its deposits by Rs. 58192.152 Million to produce same level of outputs or it should increase its outputs by Rs. 316.004 Million using same level of inputs, to overcome its inefficiency. The Syndicate Bank can improve its efficiency by either decreasing its deposits by Rs. 248081.284 Million to produce same outputs or by increasing its output by Rs. 3652.872 Millionusing same inputs. The Union Bank of India should decrease its borrowings by Rs. 34306.102 Million and the Vijaya Bank should decrease its deposits by Rs. 44135.743 Million to become an efficient bank.

FINDINGS & CONCLUSIONS

From the foregoing analysis, the findings can be summarised as follows:

- In the entire public sector bank group, 12 out of 26 banks are efficient. Rest 14 banks are inefficient. It means that majority of the public sector banks are inefficient. Thus, alternative hypothesis $H_{1,1}$, i.e. majority of the public sector banks are efficient, is rejected and null hypothesis $H_{1,0}$, i.e. majority of the public sector banks are inefficient, is accepted.
- In State Bank Group, 4 out of 6 banks are efficient and 2 banks are inefficient under the category of public sector banks. Thus null hypothesis, $H_{2,0}$: Majority of the banks in the State Bank Group are inefficient, is rejected and the alternative hypothesis, $H_{2,1}$: Majority of the banks in the State Bank Group are efficient, is accepted.

- In nationalised bank category, including other public sector banks, 7 out of 20 banks are efficient. Rest 13 banks are inefficient. Thus, $H_{3,0}$: Majority of the banks in the Nationalized Bank Group are inefficient, is accepted and $H_{3,1}$: Majority of the banks in the Nationalized Bank Group are efficient, is rejected.
- Only 14% banks are inefficient due to deficiency of Other Income. Thus $H_{4,0}$: Lack of other income is the main source of inefficiency in Public Sector banks, is rejected and $H_{4,1}$: Lack of other income is not the main source of inefficiency in Public Sector banks, is accepted.
- It is found that improper utilization of owned funds & wages is the major source of inefficiency in 7% public sector banks each. Deposits are the main source of inefficiency in 43% public sector banks. Borrowings are the major source of inefficiency for 64% banks. Thus $H_{5,0}$: Utilization of input variables i.e. Capital, Business and Wage Bills is the main source of inefficiency, is partially accepted.

Thus it is concluded that majority of the public sector banks are inefficient. Under this category, majority of State Bank group banks are efficient and majority of nationalised banks are inefficient. Further, the excessive borrowings are the major source of inefficiency followed by unutilised deposits, owned funds and wages. In order to improve efficiency, public sector banks should improve their credit-deposit ratio and should reduce the level of borrowings. Alternatively, borrowings can be utilised in a way to earn more spread. Overall it can be concluded that the DEA calculates efficiency, sources of inefficiency and helps in establishing benchmarks for improving efficiency.

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